DETERMINANTS OF ADOPTION OF IMPROVED CASSAVA VARIETIES AMONG FARMING HOUSEHOLDS IN OGUN STATE, NIGERIA

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ABSTRACT

This paper examines the adoption of improved cassava varieties among farming households in Ogun State, Nigeria. Multi-stage sampling procedure was adopted to collect data from 216 cassava farming households in Odeda, Ifo, Yewa South and Imeko-Afon Local Government Areas with the aid of structured questionnaire. Both descriptive and quantitative methods were used in the analysis of the study data. While Logit model was used to determine the factors affecting adoption of improved cassava varieties, Tobit model was used to determine the factors affecting the ratio of land allocated to improved cassava varieties. Tobit regression results indicated that farmer's experience ($p<0.01$), farmer's education ($p<0.05$), household size ($p<0.05$) and extension contact ($p<0.01$) significantly influenced intensity of adoption of improved cassava varieties. It is therefore, recommended that the farming households should make use of improved cassava varieties, form an effective linkage with the extension services and endeavour to be an active mêmber of farmer's association in their community.

Keywords: Adoption, Improved Cassava, Farming Households, Ogun State

INTRODUCTION

The Agricultural sector remains a dominant sector in the Nigeria economy in terms of its being a source of food and contributes about 33% to the Gross Domestic Product (GDP) of the nation (Bureau of African Affairs, 2010). The sector employs about one third of the total labor force and provide a livelihood for the bulk of the rural populace (FMARD, 2006). However, with the discovery of petroleum the attention of government was diverted away from agriculture. As such, the sector failed to keep pace with the demand of households and industries for food and raw materials while its contribution to GDP has also fallen drastically (Nwaiwu et al., 2010).

In view of the importance of the sector to the development of the economy, government at both federal and state levels have been making effort since the return of democracy in 1999 to restore the past glory of the country back to agriculture and one major crop that has received the attention of government was cassava production. Mafimisebi (2008) observed that due to the recent discovery of the potential of cassava as a foreign exchange earner, there has been a strident call by policy makers to increase it cultivation.

According to Food and Agriculture Organization of the United Nations (FAOSTAT, 2009), Nigeria is the largest producer of the crop with 45,721,000, 43,410,000 and 44,582,000 million tonnes in 2006, 2007 and 2008 respectively. Comparing the output of various crops in Nigeria, cassava production ranks first with annual production of 34 million tones, followed by yam production at 27 million tonnes, sorghum at 7million tonnes, millet at 6million tonnes and rice at 5 million tones but most of this are however consumed as food (FAO, 2004, Awoyinka, 2009).

James et al. (2011) further observed that Nigeria is yet to fully harness the socio-economic potentials of Cassava that would translate to higher ranking of Cassava next to petroleum as major contributor to the Gross Domestic Product (GDP). Therefore, to boost cassava production for both domestic consumption and exportation, a number of new initiatives are currently being implemented to increase cassava yields and production in Nigeria. One of such initiative is distribution of high yielding varieties to farmers and improving farming practices. It is believed that if each Local Government area participating in the Cassava Growers Association plants 1000 ha of high yielding cassava, this would increase production by 16.5 million tonnes achieving more than half of the targeted increase of 26 million tonnes by 2007 (IFAD, 2004).

Adoption of improved crop varieties and adequate use of fertilizer has been found to increase agricultural output (Ogunlade et al. 2009). One of the push factors also suggested by (IFAD, 2004) was the introduction of improved varieties as a means to increasing cassava yield.

However, the problem is that these improved varieties are not yet widely adopted. The problem of adoption as identified by Rahji (2005) centres on understanding the adoption behavior of farmers and the improved production technology available and attainable. It also borders on examining how the improved practices will lead to a structural shift in the production parameters and efficiency of the farmers. In view of this, an analysis of the adoption of improved varieties among cassava farming households in Ogun state becomes imperative. This will help to determine the factors influencing the adoption of improved varieties of cassava and the factors influencing the proportion of land allocated to the cultivation of improved cassava varieties.

THEORETICAL FRAMEWORK

Qualitative choice model such as linear probability model (LPM) has been used by several authors in explaining discreet decision making in adoption studies. Two transformations of the LPM which bounds probability values within (0, 1) are the Probit and Logit models (Pindyck and Rubinfeld, 1981; Agada and Phillip, 2002; Agbeniyi et al., 2010). These models specify a functional relation between the probability of adoption and various explanatory variables. Binary choice models assume that individuals are faced with two alternatives and the choice made will depend on the characteristics of the individuals and this must be described in probabilistic term.

Generally, the logit model requires more data than the probit model and its dependent variable must be specified in a ratio form unlike the probit in which it takes values of 1 or 0. The logit model is easier to use for computation and is therefore often used as a substitute for the probit model. It has also been found useful and widely used in literature in determining the variables influencing adoption in a study of high yield varieties (Asaduzzaman, 1979; Cavane, 2009; Agbeniyi et al., 2010). Therefore, for this study logit and tobit models were used. While logit model measures adoption on a dichotonomous basis, tobit on the other hand examine the extent and intensity of use of the new technology.

Tobit Model

The Tobit model is a special case of a censored regression model because the latent variable yi* cannot always be observed while the independent variable Xi is observable .When the variable is censored, the OLS regression will give inconsistent estimates of the parameter, that is, it will yield a downward biased estimate of the slope coefficient and upward biased estimate of the intercept. This means that the sample data is not a true representative of the population. Truncation occurs when the sample data is drawn from a subset of a larger population. However, Amemiya (1973) has proved that maximum likelihood estimator suggested by Tobin for this model is consistent.

The Tobit model developed by Tobin may be expressed as

$$Y^* = X\beta + \square \text{ ------------------------ } (1)$$

Where, β is a vector of unknown coefficients, X is a vector of independent variables □ is an error term that is assumed to be independently distributed with mean zero and constant variance,Y* is a latent variable that is unobservable. If data for the dependent variable is above the limiting factor, zero in this case, Y is observed as a continuous variable

If Y is at the limiting factor, it is held at zero. This is presented mathematically as

$$Y = \quad Y^* \text{ if } Y^* > Yo \text{ ----------------- } (2)$$
$$Y = \quad 0 \text{ if } Y^* \leq Yo \text{ ------------------- } (3)$$

Where Y0 is the limiting factor. These two equations i.e the resulting sample Ys represent a censored distribution of the data.The Tobit model can be used to estimate the expected value of Y1 as a function of a set of explanatory variable (X) weighted by the probability that Y1 > 0. Maddala shows that the expected intensity of adoption, E(Y) is

$$E(Y) = X\beta F(z) + \sigma f(z) \text{ and } Z = X\beta/\sigma$$

Where, F(z) is the cumulative normal distribution of z, f(z) is the value of the derivate of the normal curve at a given point. Z is the Z- score for the area under the normal curve.

The coefficients for variables in the model, β, do not represent marginal effects directly, but the sign of the coefficient will give the researchers information as to the direction of the effect.

METHODOLOGY

Study Area

The study focused on analysis of adoption of improved varieties among cassava farming households in Ogun state, in the South Western zone of Nigeria. The state is made up of 20 Local Governments and covers a land area of about 16,409.26 sq Km with a population of 3,728,098 as at 2006. The state has a tropical climate with mean rainfall between 1,110 –1,500 millimeters. It is bounded in the south by Lagos State and the Atlantic Ocean, in the East by Ondo State and in the North by Oyo and Osun States. The climate is tropical characterized by bimodal rainfall season that start about March and ends in August. The second rainy seasons begin on September and ends in November. The main food crops produced in the state include cereals, root and tubers, grain legumes, groundnuts and a variety of vegetable and tropical fruits.

Sampling Technique

This study was conducted on cassava farming households in Ogun State with the aid of interview and questionnaire. A multi stage sampling procedure was used to select the respondents for the study. In the first stage, two Agricultural Development Programme (ADP) zones i.e Abeokuta and Ilaro were randomly selected from four zones. In the second stage, four local governments were purposively selected from the Agricultural Development Programme (ADP) Zones in the state based on the prominence of cassava cultivation in the area. The LGAs selected are Odeda and Ifo in Abeokuta zone while Yewa South and Imeko-Afon was chosen from Ilaro zone. In the third stage, five farming communities were randomly selected in each of the LGAs using the list obtained from OGADEP thus giving a total of 20 communities. In the last stage, between 10 and 15 households were purposively selected in each community on the basis of having sole cassava plot thus giving a total of 225 cassava farming households. However, only 216 cassava farming households were used for the study.

Analytical Techniques

Both descriptive and quantitative method was used in the analysis of the study data.

In this study, Logit model was used to determine the factors affecting adoption of improved cassava varieties (incidence of adoption) while Tobit model was used to determine the factors affecting the allocation of land to improved cassava varieties (intensity of adoption). Therefore, the study is interested in the probability of adoption as well as the level of adoption because it is assumed that a farmer first adopts the variety, and then decides the size of land to be allocated for the variety adopted.

The logistic (logit) probability function is given as

$$Pi = 1/1+e\text{-}zi = f(Z_i) \text{ --------------(4)}$$

Where Pi is the probability that an individual farmer i (i = 1, 2 ... n) will make a particular choice given the information embodied by index Zi. Index Zi is a random variable which predicts the probability of adoption of improved varieties by this relationship.

$$Pi = \frac{ezi}{1 + ezi} \text{ ---------------------------(5)}$$

Therefore for the ith observation, an individual farmer will be

$$Zi = In \frac{Pi}{1 - Pi} = \beta o + \Sigma\beta o X \text{ -----------(6)}$$

$$Zi = \beta o + \beta i X ij + \beta 2 X2j + \ldots\ldots\ldots + \beta kXkj \quad (7)$$

Therefore, Log (p/1-P) = 1, if adopted while Log (p/1-P) = 0, if otherwise

Implicitly, the Logit model is empirically estimated as

$$Y = \beta o + \beta i Xi + \beta 2 X2 + \beta 3 X3 + \beta 4 X4 \ldots\ldots\ldots\ldots \beta 10 X10 + \sqcup \text{ ---------------(8)}$$

The Tobit model is represented as

$$Yi^* = B Xi + e \text{ ----------------------------(9)}$$

Where

Yi* is a latent variable (unobserved for value smaller than zero)

X is a vector of independent variables

β is a vector of unknown parameters

e is an error term assumed to be independently and normally distributed with zero mean and constant variance

Denoting Yi as the observed dependent (censored) variable and is related to Y* as follows:

$$Y_i = \begin{cases} Y_i^* & \text{if } Y_i^* > 0 \\ 0 & \text{if } Y_i^* \leq 0 \end{cases} \quad \text{-------------------(10)}$$

Where:

Y = Adoption of improved cassava varieties (1 if adopted, 0 if otherwise) or the proportion of land allocated to the cultivation of improved cassava varieties

X1 = Age of Household heads (years), X2 = Farm size (ha), X3 =Farming experience (years)

X4 = Level of education (years), X5 = Access to credit (1 if access and 0 if no access)

X6 = Household size, X7 =Cassava output (kg/ha), X8 =Contact with extension agent

X9 = Membership of farmers' association (Dummy), X10 =Gender of household head,

[ ] = errors term

RESULTS AND DISCUSSIONS

Description of the Socio-economic Characteristics of Cassava Farming Households

The study as shown in table 1 found that majority of the households heads (80.6%) are male having their age in the bracket of 41-50 with mean age of 47 years. Over 87% of the household heads are married while 35.2% and 7.4% are having secondary and tertiary education respectively. Furthermore, over half of the cassava farming households maintained a household size that is above four with mean farm size of 1.6 ha. However, 33.6% have had between 11-20 years of farming experience with mean experience of 24 year. While 58.3% had no access to credit, 60.2% were observed to be member of farming association. Majority of the farmers planted Somidoloro, Idileru, Oko Iyawo, TME 419 and TMS 30572 varieties.

Figure in parenthesis are the standard deviations

Table 1 : Socio-economic Characteristics of respondents

Variables	Frequency	Percentage
Gender		
Male	174	80.6
Female	42	19.4
Total	216	100
Age (years)		
< 30	4	1.9
31-40	50	23.1
41-50	74	34.3
51-60	38	17.6
> 60	50	23.1
Total	216	100
Mean Age	47 (8.350)	
Level of Education		
None	60	27.78
Primary education	64	29.63
Secondary education	74	34.26
Tertiary	18	8.33
Total	216	100
Household size		
Below 1-3	92	42.6
Above 4-6	124	57.4
Total	216	100
Mean HHZ	4 (1.754)	

Source: Field Survey Data, 2010

Figure in parenthesis are the standard deviations

Determinants of adoption of improved Cassava Varieties in the study area

The estimated coefficient for the likelihood ratio chi-square was significant at 1 percent. The result of the logit regression analysis in table 3 indicated that farmer's experience ($p<0.05$), output/ha ($p<0.05$), household size ($p<0.01$), extension contact ($p<0.05$), membership of association ($p<0.05$) and gender of household heads ($p<0.10$) were positive with the exception of household size (which was negative) and they significantly influence the probability of adopting improved cassava varieties. The implication is that a unit increase in farmer's experience, extension contact, membership association and output per hectare will increase the likelihood of adopting improved cassava varieties by 2.4%, 46%, 82% and 79% respectively. This conforms to the findings of Omonona et al. (2006). Other variables such as age, farm size and access to credit were not significant factors in adoption of improved cassava varieties in the study area.

Table3: Logit Model result on the determinants of adoption of improved cassava varieties

Variable	Coefficient	Standard Error	t-ratio
Constant	0.471	1.235	0.381
Age	0.035	0.032	1.076
Farm Size	0.190	0.440	0.432
Farming Experience	0.024**	0.029	2.243
Education	-0.021	0.048	0.421
Farm Output/ha	0.0101**	0.049	2.060
Access to Credit	0.231	0.385	0.599
Household Size	-0.092***	0.119	-2.776
Extension Contact	0.456 **	0.383	2.116
Membership of Assoc.	0.842 **	0.451	2.029
Gender	0.790*	0.439	1.799

Source: Field Survey Data, 2010

Log likelihood 17.800

Chi-square 32.721***

*** = Significant at 1 percent, ** = significant at 5 percent, * = Significant at 10 percent

Determinants of the Proportion of Land allocated to improved Cassava Varieties

Result of the Tobit model for the determinant of proportion of land allocated to improved cassava varieties is presented in Table 4. The Tobit model was used because the proportion of land allocated to improved cassava varieties is a continuous variable but truncated between zero and one. From the maximum likelihood estimates of Tobit regression, the result showed that the sigma was significant ($p<0.05$) implying that the model was fit to the data and conforms to the findings of Omonona et al. (2006). Out of all the variables fit into the model only farmer's experience ($p<0.01$), farmer's education ($p<0.05$), household size ($p<0.05$), extension contact ($p<0.01$) and output per hectare ($p<0.05$) significantly influenced the probability that more land would be allocated

Table 4: Tobit Model result on the determinants of the proportion of land allocated to improved cassava varieties

Variable	Coefficient	Standard Error	t-ratio
Constant	5.167***	0.680	7.593
Age	0.021	0.014	-1.525
Farming Experience	0.023***	0.012	2.883
Education	0.027**	0.022	2.022
Access to Credit	-0.036	0.164	-0.215
Household Size	-0.107**	0.052	-2.066
Extension Contact	0.322***	0.172	3.875
Farmer Association	-0.125	0.201	0.621
Gender	0.280	0.199	-1.407
Output/ha	0.385**	0.169	2.278

Source: Field Survey Data, 2010

Sigma 2.223**

Log likelihood 17.975

*** = Significant at 1 percent, ** = significant at 5 percent, * = Significant at 10 percent

to improved cassava varieties. It is important to point out that experience, education, extension contact and output per hectare have positive effect while household size has negative impact. The farmer's household size was important in the adoption analysis and negative implying that the larger the farmers household size, the lower the probability of adopting improved cassava varieties by farmers. Therefore, a unit increase in farmer's household size reduces the likelihood of allocating more land to improved cassava varieties by about 11 percent. This contradicted the findings of Omonona et al. (2006) which stated that household size was not a significant factor in the adoption analysis. Farmer's experience, education, extension contact and output per hectare exert positive effect which implies that increase in any of these factors will increase the allocation of land to improve cassava varieties. Therefore, a unit increase in farmer's experience, farmer's education, extension contact and output per hectare increases the allocation of land to improved cassava varieties by 0.023, 0.027, 0.322 and 0.385 respectively.

CONCLUSION AND RECOMMENDATION

This study had successfully shown the various factors influencing the adoption and the proportion of land allocated to the cultivation of improved cassava varieties in the study area. Some of the factors include farmer's experience, farmer's education, access to extension services, household size and gender of household heads. Therefore, farmers need to take full advantage of new technology such as improved varieties in order to boost cassava production in the state. Based on the findings, it is recommended that the farming households should make use of improved cassava varieties and form an effective linkage with the agricultural extension services. These will ultimately translate into increased income for the farmers through improved cassava yield. In addition, the education of the farmers and the household members should be given priority while they should be encouraged to be members of association in their community in order to have access to network of information that will aid the farmer's adoption process.

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Table 2 : Farm Characteristics

Variables	Frequency	Percentage
Farm Size		
< 0.49	16	7.4
0.50-0.99	52	24.1
1.00-1.49	72	33.3
1.50-1.99	46	21.3
2.00-2.49	8	3.7
> 2.50	22	10.2
Total	216	100
Mean Farm Size	1.6 (1.164)	
Farming Experience		
1-10	38	17.6
11-20	72	33.6
21-30	36	16.7
31-40	34	15.7
41-50	22	10.2
> 50	14	6.5
Total	216	100
Mean Farm Exp.	24 (15.568)	
Access to Credit		
No Access	126	58.3
Access to credit	90	41.7
Total	216	100
Membership of Farmers' Association		
None	86	39.8
Membership of association	130	60.2
Total	216	100
Farmers Status		
Adopters	172	79.62
Non-Adopters	44	20.37
Total	216	100
Reasons for Planting		
Early maturity	10	4.6
Good for environment	36	16.7
Quality tuber	8	3.7
Resistance to diseases	14	6.5
Yield increase	144	66.6
Variety available	4	1.9
Total	216	100
Sources of Varieties		
ADP	28	13.0
Farmers Group	13	6.0
Last Season	139	64.4
RTEP	36	16.7
Total	216	100

Source: Field Survey Data, 2010